TABLE III

| Ratios | Obs. C. | Obs. R. |
|---|---|---|
| Latent interval / After-sensation | 0.528 | 0.587 |
| After-image / After-sensation | 4.27 | 3.89 |
| After-image / Latent interval | 7.884 | 6.625 |

TABLE IV

| Ratio | After-sensation | Latent Interval | After-image |
|---|---|---|---|
| Obs. R. / Obs. C. | 7.9 | 8.5 | 7.2 |

*Conclusions.*—The results we have obtained seem to agree roughly with those of Hayes, though her findings are not given in a form that permits of direct comparison. Our results show the same wide variation for each observer and between observers; and the ranges of variation are approximately the same. We found the after-sensation always present. After-images were reported in a much larger number of cases than by Hayes. This difference may be due to the difference in the stimulus employed. Whether the relation which we have found between our two observers appeared in Hayes' work it is impossible to tell, but her "quantitative individual tables" indicate that an observer's times were either all long or all short.

## XXXIII. On Perceptive Forms below the Level of the Two-Point Limen

By E. de Laski

It is clear from the results obtained by Gates [1] and Titchener [2] that certain of the perceptive patterns which occur below the level of the cutaneous two-point limen are sufficiently stable for quantitative determination. It seems desirable that the whole range of these patterns [3] be systematically explored, and the present paper records a first beginning of such exploration.

[1] E. J. Gates, The Determination of the Limens of Single and Dual Impression by the Method of Constant Stimuli, this Journal, xxvi, 1915, 152ff.

[2] E. B. Titchener, in *Proc. Amer. Philos. Soc.*, lv, 1916, 208ff.

[3] For the patterns in general see M. Foucault, L'illusion paradoxale et le seuil de Weber, 1910, 124f.

The work was done during the Summer Session of 1916. The stimuli were applied by an improved Jastrow aesthesiometer to the volar side of the right arm. A line about 8 cm. in length was marked longitudinally upon the skin, beginning at a point about 2.5 cm. above the wrist; veins and hard tissues were avoided. The points were set down at different parts of this line. (It may be said at once that the area of stimulation was too large; both observers complained that the perceptive patterns varied from part to part of the line. It is better to adopt a smaller area, and to prevent fatigue by taking the observations slowly.) The observer's arm was fixed in a rest, and the aesthesiometer was applied by hand. The observers were Dr. J. N. Curtis, and Mr. F. L. Dimmick, assistant in the department.

The plan of work was as follows. Two stimuli, below the two-point limen, were chosen, and were given with knowledge in a practice-series of 10 to 20 observations (usually the same number for each stimulus). The observer was to memorise the perceptive forms and to give them names. Thereafter the experiment proper was performed: haphazard series were made up of 20 terms (10 of each stimulus), and the observer was required to name the forms as they occurred. In all cases but one, the blunt point formed by apposition of the aesthesiometer-points was used as one member of the stimulus-pair. We hoped to compare with one another all the separations employed, but lack of time forbade. The order in which the experiments were taken is shown in the following tables; the total number of judgments indicates roughly the difficulty of establishing the particular form under observation.

OBSERVER C

| Stimuli | Total number of judgments | Number of Errors | | Per cent accuracy | Maximal per cent accuracy in a single series |
|---|---|---|---|---|---|
| | | With lesser stimulus | With greater stimulus | | |
| App., 40 mm. | 40 | .. | .. | 100 | 100 |
| App., 25 | 160 | 29 | 20 | 69 | 85 |
| App., 20 | 20 | 0 | 2 | 90 | 90 |
| App., 15 | 120 | 14 | 20 | 72 | 80 |
| App., 10 | 280 | 54 | 56 | 61 | 85 |
| 10, 20 | 140 | 20 | 19 | 72 | 85 |

In the first five of these experiments C judged in terms of *line* and *spot*. The *spot* was "a fairly round one with a hard place in the middle (deep, thick place)." The 40 mm.-pattern was a line with several points in it. The remaining *lines* were of the dumb-bell kind: "a vague oval with foci quite prominent and a tight little line connecting the foci." The patterns in the sixth experiment were distinguished merely by the length of this connecting line. C's patterns were, unfortunately, blurred by the shift of the stimuli along the 8 cm.-line of stimulation; she sometimes felt additional points within (or beyond?) the dumb-bell. The distribution of errors is, nevertheless, fairly regular.

OBSERVER D

| Stimuli | Total number of judgments | Number of Errors | | Per cent accuracy | Maximal per cent accuracy in a single series |
|---|---|---|---|---|---|
| | | With lesser stimulus | With greater stimulus | | |
| App., 30 mm. | 120 | 13 | 23 | 70 | 95 |
| App., 25 | 20 | 3 | 1 | 80 | 80 |
| App., 20 | 60 | 10 | 7 | 72 | 85 |
| App., 15 | 220 | 33 | 29 | 72 | 95 |
| App., 10 | 200 | 22 | 29 | 75 | 95 |

In all these experiments D judged in terms of *long* and *blunt*. The latter he described as "a pressure both cutaneous and subcutaneous, a blurry shapeless spot, dull." The *longs* varied from indefinite ovals to "just a larger and more blurry mass, perhaps greater in pressure than the blunt." D was usually fatigued at the time of the experiments, and the fatigue seems to have affected the definiteness of his reports, though not his numerical accuracy. He complained, as C did, of the change of pattern with shift of stimulation. The distribution of errors is, again, fairly regular.

*Conclusions.*—It seems certain that subliminal separations of the aesthesiometer-points are discriminable. This result has an obvious bearing upon the determination of limens.

Discrimination appears to be based not upon length (quantitative) but upon form (qualitative); for the percentage of accuracy does not vary with the difference between the two stimuli. Moreover, we do not find any progressive effect of practice.

The introspective reports also point to the conclusion that perceptive form is the basis of judgment. C remarked, incidentally, that repetition fatigued her, and was a hindrance rather than a help.

This preliminary work shows that the stimuli should be applied (1) within a small area, (2) with light pressure, and (3) with fairly long time-intervals (perhaps 40 to 50 sec.) between the stimulus-pairs.

We have still to determine whether the perceptive forms constitute a series, and if so whether the series is continuous or discrete; and to work out the number of just noticeable differences between the perception of 'spot' or 'point' and the two-point limen.